Rupture of abdominal aortic aneurysm previously treated by endovascular stentgraft

Giovanni B. Torsello, MD, Eckhard Klenk, MD, Bernd Kasprzak, MD, Thomas Umscheid, MD *Münster and Frankfurt, Germany*

We describe a case of abdominal aortic aneurysm (AAA) with rupture 16 months after treatment by an endograft. A 76-year-old patient on Coumadin after aortic valve replacement had initially successful exclusion by stentgraft. There was no evidence of an endoleak seven months after stentgraft repair, although a computed tomography scan detected an enlargement of the aneurysm sac. Sixteen months after initial endograft surgery, rupture of the aneurysm occurred and we performed open emergency surgery. We treated the aneurysm by conventional technique, and the patient survived the rupture. This case emphasized the fact that patients after endograft AAA repair require a close follow-up. An expansion of the aneurysm sac after the procedure should signal failed exclusion, even if a computed tomography scan does not demonstrate an endoleak. Anticoagulation can be an important factor in failure after endoluminal graft treatment. Supravisceral aortic cross clamping is helpful in dealing with a stented aorta.
(J Vasc Surg 1998;28:184-7.)

Since the introduction of endovascular techniques, a growing number of patients have been treated by endovascular implantation of a stentgraft prosthesis for infrarenal aortic aneurysm.[1] Early results suggest this less invasive treatment can effectively exclude abdominal aortic aneurysm (AAA) from circulation, avoiding major abdominal surgery and the related morbidity and mortality.[2] However, the use of this new technique raises many questions, which currently can be answered only partially by the available short follow-ups. Whether and to what extent we can expect the stent to prompt shrinkage of the aneurysm or promote further dilatation is still not established. Different reports examining aneurysm size after endovascular grafting[3,4,5] show that aneurysms shrink following successful endovascular treatment and enlarge when there are persistent endoleaks. Occasionally, aneurysms continue to enlarge although a perigraft flow is not visible. [4,5] The role of nonmorphological factors such as anticoagulation in the success or failure of stentgrafts is unknown. The primary aim of aneurysm treatment is to avoid death due to rupture, but fundamental questions remain about the long-term safety and effectiveness of endovascular treatment to permanently avoid death.[6] This report describes the special features of surgical technique in dealing with a stented aorta and highlights the possible causes for aneurysm sac enlargement and rupture.

CASE REPORT

A 76-year-old man underwent endovascular grafting in December 1995. The patient's medical history included bilateral gunshot injury of the lung during World War II, chronic obstructive pulmonary disease, and atrial fibrillation. Surgeons treated the patient's coronary artery disease and aortic valve stenosis with an aortocoronary bypass and aortic valve replacement in 1992, consequently placing the patient on permanent oral anticoagulation medication. The AAA was known to exist for several years, but other facilities had turned down the patient for open surgery because of the great number of coexisting morbid conditions. The maximum aneurysm diameter before the procedure was 6.5 cm on computed tomography; the aneurysm neck was cylindrical, 15 mm long, and 25 mm wide with a thin adherent thrombus on the left side (Fig. 1).

The endovascular procedure presented some difficulties. The primary component (aortic body, 26 mm in

From the Department of Vascular Surgery, St Franziskus Hospital, Münster, Germany, and the Department of Surgery (Dr. Umscheid), City Hospital, Frankfurt, Germany.
Reprint requests: Prof. Dr. Giovanni B. Torsello, Department of Vascular Surgery, St. Franziskus Hospital, Hohenzollernring, 72, D-48145 Münster, Germany.

0741-5214/98/$5.00 + 0 **24/4/90596**

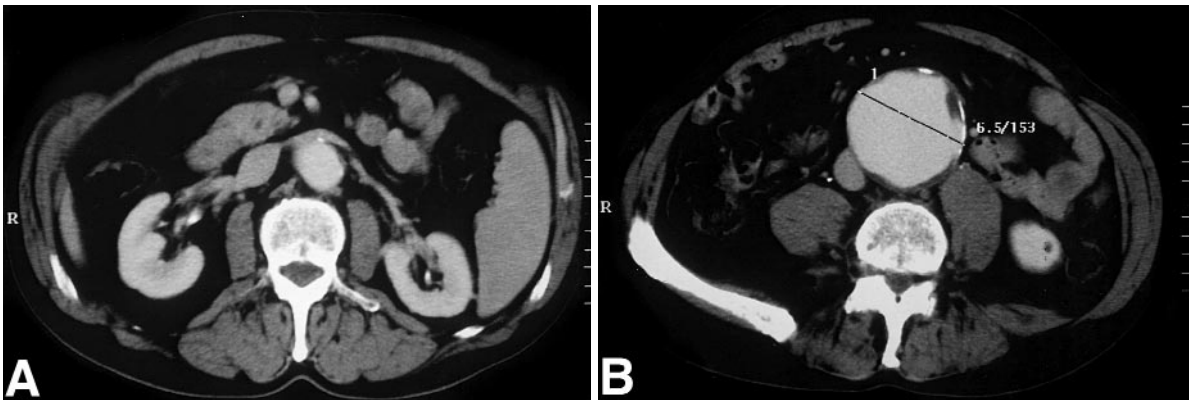

Fig. 1. Preoperative computed tomography scan showing the cephalad neck **(A)** and the aneurysm sac **(B)** of the AAA before endoluminal treatment.

Fig. 2. Computed tomography scan of the same patient seven months after endoluminal grafting of the AAA. The size of the neck **(A)** had not changed significantly. Contrast is seen only in the aorta and inside the graft. The size of the aneurysm sac has increased **(B)** although endoleak is not evident.

diameter, and right iliac limb) of a Stentor bifurcated system (MinTec Co., Freeport, Bahamas) was implanted, but adjustment of the left limb at the attachment site of the primary graft could not be achieved. In a second attempt one day later, the team succeeded in placing the secondary component in the left iliac artery and connecting it to the primary graft. The patient was discharged from the hospital eight days later. A postoperative computed tomography scan showed a regular position of the stentgraft without signs of endoleak. Seven months later, in June 1996, a mitral balloon valvuloplasty became necessary for mitral valve stenosis. Before the procedure (which was performed successfully), a computed tomography scan of the abdomen (5 mm cuts without delayed images) was carried

Fig. 3. Postprocedural computed tomography reconstruction showing the position of the implanted stentgraft in a longitudinal view and the tortuosity of the aorta at the level of the upper limit of the stent.

out. The study showed an infrarenal AAA enlargement greater than 7 cm, no evidence of an endoleak (Fig. 2) and a tortuosity of the aorta below the origin of the renal arteries (Fig. 3). A pulsatile mass was not present. A computed tomography scan scheduled for follow-up in December 1996 was not peformed.

Nine months later, a community hospital admitted the patient with a three-hour history of abdominal and back pain. On examination, the patient was pale with a tender abdomen and a palpable pulsatile abdominal mass. Physicians detected a weak femoral pulse on both sides. The coagulation profile showed a partial thromboplastin time of 56 seconds, a prothrombin time of 21% and an international normalized ratio of 3.5. Abdominal ultrasound showed an AAA enlarged to 8.2 cm in diameter and rupture into the right retroperitoneum. Due to the patient's emergency status, they did not perform a computed tomography examination, but immediately referred the patient to our department. After performing standard longitudinal laparotomy, we found a large retroperitoneal hematoma and 300 ml blood in the abdomen. Because of the large hematoma and the history of stentgraft implantation, we primarily performed supravisceral aortic cross clamping. After opening the aneurysm sac, we found a gap filled with fresh thrombi between the aneurysm neck and the cephalic part of the stentgraft. We did not detect a gross migration of the device distally. After transversal division of the stent, we extracted the proximal portion of the graft. Thereafter, we positioned the aortic clamp below the origin of the renal arteries. We initially left the distal bifurcated part of the graft in position and cross-clamped it to avoid iliac back bleeding. Before performing the distal anastomosis, we removed the stentgraft and blocked the common iliac arteries with balloon catheters. We found the lumbar arteries and the inferior mesenteric artery occluded. There was neither visible dislocation nor mechanical defect of the graft. The secondary component was not disconnected. Smooth fibrous tissue covered the stent at the outside and a neointima layer inside. After removing the thrombi, we implanted a 16/8 mm gelatin coated bifurcated Dacron graft (Braun Co., Melsungen, Germany). After the procedure, the patient was transferred to the intensive care unit and extubated 24 hours later. On the third postoperative day, he developed bronchopneumonia that we successfully treated. The postoperative computed tomography scan showed a normal patency of the prosthesis and no signs of infection. The patient was discharged two weeks later, and he is doing well one year after his last operation.

DISCUSSION

Based on short-term results, endovascular repair of AAA is feasible, reasonably safe and effective.[7-9] However, persistent endoleaks, peripheral embolization, renal dysfunction and intestinal infarction have occurred.[10-12] Little is known about the fate of patients after several years. Literature has reported some cases of rupture of AAA following endovascular graft placement.[1,13,14] The cause of rupture was a persistent perigraft flow due to proximal or distal leak. In this case, acute aneurysm rupture occurred 16 months after endograft stenting despite the assumption that the AAA had been treated successfully.

The cause of rupture was not certain. Computed tomography studies postoperatively and seven months after the procedure showed no endoleak and no migration of the stent. The diameter of the aneurysm neck did not change significantly. Despite these findings, a follow-up computed tomography scan seven months after the procedure found an increase in the diameter of the aneurysm sac. Usually, successful endovascular treatment of AAA results in a slight reduction of the aneurysm diameter after 12 months and a substantial shrinkage after two years.[3,4,5,12,15] Patients with expansion of the aneurysm sac have persistent perigraft flow.[3,4] Fogarty [4] notified an initial seal after endograft management can convert to a late leak, and aneurysms can continue to enlarge even if a leak is not identified. Since computed tomography scanning in this case was not supplemented with delayed images, we cannot exclude slow flowing channels as a cause of endoleak. Whether or

not computed tomography scans fail to show a leakage as in this case, an increase of aneurysm diameter should be a warning sign of insufficient exclusion of the AAA. These findings should suggest an aggressive approach, including angiography and adequate aneurysm repair.

Since we did not detect migration or mechanical defect of the graft and we did not find back bleeding from the side branches during the operation, other factors must have played a role in the rupture of the aneurysm. Preoperative computed tomography scans showed an aneurysm with a prohibitively short (15 mm) and wide (25 mm) neck with a small adherent thrombus. Although the stent-graft has technically been placed in the correct position and the presence of thrombus in the neck was minimal, the tortuosity of the proximal aneurysm neck (shown on follow-up computed tomography scan) may have precluded adequate graft-to-aorta apposition and induced the bleeding beside the stent. Results of recent animal studies[16] suggest the thrombus formation after deployment of a porous stentgraft can transmit the pressure to the aneurysm wall. These findings may explain the enlargement of AAA even in cases without evident endoleak.

We initially performed supravisceral cross-clamping and easily removed the stent after opening the aneurysm sac with no damage to the aortic or iliac wall. Afterwards, we clamped the aorta below the origin of the renal arteries and continued the procedure as a regular surgical AAA exclusion by graft inclusion technique. Ultimately, the cause of the rupture is uncertain, but the question remains whether factors, such as anticoagulation therapy (Coumadin or heparin) and "borderline" aneurysm neck, should be cause for exclusion from this type of therapy. The personal experience of one of the authors (Thomas Umscheid, personal communication) shows perigraft flow disappeared in a patient after discontinuing chronic anticoagulation.

In conclusion, length, angulation and shape of the aneurysm neck, the presence of thrombus in the proximal neck and the migration of the device are possible factors for graft failure after endovascular management of AAA. Since we detected no important changes in the position of the device, the cause of enlargement and rupture of AAA remains unclear.

Patients after endograft AAA repair require close follow-up. Expansion of the aneurysm sac should signal failed exclusion, even if a computed tomography scan cannot detect an endoleak.

We thank Amy Wirtz Newland and Doris Kloppenborg for editorial assistance.

REFERENCES

1. Parodi JC. Endovascular repair of abdominal aortic aneurysm and other arterial lesions. J Vasc Surg 1995;21:549-57.
2. Blum U, Voshage G, Lammer J, Beyersdorf F, Töllner D, Kretschmer G, Spillner G, Polterauer P, Nagel G, Hölzenbein T, Thurnher S, Langer M. Endoluminal stentgrafts for infrarenal aortic aneurysms. N Engl J Med 1997;336:1-13.
3. Balm R, Kaatee R, Blankensteijn JD, Mali WPTM, Eikelboom BC. CT-angiography of abdominal aortic aneurysms after transfemoral endovascular aneurysm management. Eur J Vasc Endovasc Surg 1996;12:182-8.
4. Matsumura JS, Pearce WH, McCarthy WJ, Yao JST. Reduction in aortic aneurysm size: early results after endovascular graft placement. J Vasc Surg 1997;25:113-23.
5. May J, White G, Yu W, Waugh R, Stephen M, Harris J. A prospective study of anatomicopathological changes in abdominal aortic aneurysms following endoluminal repair: Is the aneurysmal process reversed? Eur J Vasc Endovasc Surg 1996;12:11-7.
6. Ernst CB. Abdominal aortic aneurysm. N Engl J Med 1993; 328:1167-74.
7. Kretschmer G, Hölzenbein T, Lammer J, Thurnher S, Minar E, Polterauer P. The first 15 months of transluminal abdominal aortic aneurysm management; a single center experience. Eur J Vasc Endovasc Surg 1997;14:24-32.
8. Moore WS. The EVT tube and bifurcated endograft system: technical considerations and clinical summary. J Endovasc Surg 1997;4:182-94.
9. May J, White G, Yu W, Waugh R, Stephen MS, Sieunarine K, Chaufour X, Harris J. Endoluminal repair of abdominal aortic aneurysms: Strength and weakness of various prostheses observed in a 4.5-year experience. J Endovasc Surg 1997; 4:147-51.
10. Sandison AJP, Edmondson RA, Panayotopoulos YJ, Reidy JF, Adam A, Taylor PR. Fatal colonic ischaemia after stentgraft for aortic aneurysm.. Eur J Vasc Endovasc Surg 1997;13:219-320.
11. Stelter WJ, Umscheid Th, Ziegler P. Schwierigkeiten und Komplikationen der transfemoralen Implantation von Stent-Prothesen beim infrarenalen Bauchaortenaneurysma. Zentralbl Chir 1996;121:734-43.
12. Malina M, Ivancev K, Chuter TAM, Lindh M, Länne T, Lindblad B, Brunkwall J, Risberg B. Changing aneurysmal morphology after endovascular grafting: relation to leakage or persistent perfusion. J Endovasc Surg 1997;4:23-330.
13. Lumsden AB, Allen RC, Chaikof EL, Resnikoff M, Moritz MW, Gerhard H, Castronuovo JJ. Delayed rupture of aortic aneurysms following endovascular stentgrafting. Am J Surg 1995;170:174-8.
14. White GH, Yu W, May J, Waugh R, Chaufour X, Harris JP, Stephen MS. Three-year experience with the White-Yu endovascular GAD graft for transluminal repair of aortic and iliac aneurysms. J Endovasc Surg 1997;4:124-36.
15. Blum U, Voshage G, Beyersdorf F, Töllner D, Spillner G, Morgenroth A, Nagel G, Schlensack C, Langer M. Two-center German experience with aortic endografting. J Endovasc Surg 1997;4:137-46.
16. Sanchez LA, Faries PL, Marin ML, Ohki T, Parsons RE, Marty B, Soeiro D, Olivieri S, Veith FJ. Chronic intraaneurysmal pressure measurement: an experimental method for evaluating the effectiveness of endovascular aortic aneurysm exclusion. J Vasc Surg 1997;26:222-30.

Submitted Jan. 5, 1998; accepted Mar. 23, 1998.